PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
P200101824 WO		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP 03/06764	27.06.2003	02.08.2002

International Patent Classification (IPC) or both national classification and IPC
G06F9/45, G06F9/45

Applicant
TELEFONAKTIEBOLAGET L M ERICSSON (Publ)

1. This International preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
19.01.2004	15.06.2004

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP 03/06764

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-50 as originally filed

Claims, Numbers

1-19 as originally filed

Drawings, Sheets

1/3-3/3 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-19
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-19
Industrial applicability (IA)	Yes:	Claims	1-19
	No:	Claims	

2. Citations and explanations

   see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 The following documents are referred to in this communication:

D1: EP 0943990 A
D2: Automatic Inference of Models for Statistical Code Compression

2 Document D1, which is considered to represent the most relevant state of the art, discloses:

a method of generating executable program code for a data processing system, the method comprising

an encoding stage (performed by the code preparation system 12) *for generating an intermediate representation* (14) *of an input code* (11), *the encoding stage comprising:*

transforming the input code (11) *including performing a selected set of code optimisation steps* (the code preparation system 12 accepts an input code, and provides a code interpretive runtime environment with optimization information, cf. page 3, line 7-10; the optimization information is obtained by performing a selected set of optimizations, e.g. the user can manually select a number of optimizations as described on page 4, line 16-22) *resulting in transformed code* (intermediate code) *and compiler information* (optimization information in the form of additional attributes added to class files 14, cf. page 3, line 12-13) *about the transformed code;*

a decoding stage (performed by the code interpretive environment) *for generating the executable program code from the intermediate representation, the decoding stage comprising:*

further compiling the transformed code using the decoded compiler information and resulting in the executable program code (the code interpretive environment further processes the intermediate code in accordance with the optimization information, and the code is executed, cf. page 3, line 15-17),

from which the subject-matter of claim 1 differs in that the encoding stage in addition comprises

extracting state information of a statistical model and statistical information from the transformed code and the compiler information; and

encoding the transformed code and the compiler information using the extracted state information and statistical information and resulting in the compressed intermediate representation;

and that the decoding stage comprises

decoding the compressed intermediate representation resulting in the transformed code and the compiler information.

The problem to be solved by the present invention may therefore be regarded as how to reduce the size of the intermediate representation.

The person skilled in the art would be aware of the teaching of document D2 that addresses the same problem. Document D2 discloses a method of compressing computer programs, and in particular of intermediate representations, wherein state information (e.g. the last few tokens seen, stack height, datatype of the top few stack elements, cf. page 243, section "IR predictors") and statistical information (a decision tree is generated and a probability distribution is associated to each leaf, cf. page 243, section "Background: Machine learning of decision trees") is extracted from an intermediate representation, and wherein said state information and said statistical information is used to encode said intermediate representation resulting in a compressed intermediate representation (cf. page 242, abstract). The method implicitly provides for decoding the compressed intermediate representation resulting in the intermediate representation. The skilled person would apply the method disclosed in document D2 to the method disclosed in document D1, thus solving the above mentioned problem. In this manner the skilled person would arrive at the subject-matter of claim 1 without having to resort to an inventive activity.

Thus claim 1 does not meet the criterion set forth in Article 33(3) PCT.

3 Dependent claims 2-11 do not appear to contain any additional features which, in

combination with the features of any claim to which they refer, meet the requirements of the PCT with respect to inventive step (Article 33(3) PCT), the reasons being as follows:

claim 2: In the method disclosed in document D1, the encoding stage is performed by a code preparation system operating on a first system (a resource rich computing environment, cf. page 3, line 13-15), and the decoding stage is performed by a code interpretive runtime environment executing on a second system (a limited resource computing environment, cf. page 3, line 15-17); the method further comprises providing the code interpretive runtime environment with the result of the encoding stage (Figure 1 and page 3, line 7-10), i.e., the intermediate representation is transferred from the first data processing system to the second data processing system.

claim 3: In the method disclosed in document D2, state information (the computed predictors mentioned on page 243, section "IR Predictors") is obtained from a state machine based on the intermediate code (the predictors being tracked with every new token read implies a state machine is present); and probability information (the probability distribution associated to each leaf of the decision tree, cf. page 243, section "Background: Machine learning of decision trees") is obtained from a statistical model (the decision tree) based on the obtained state information (the predictors).

claim 4: In the method disclosed in document D2, one of the computed predictors (page 243, section "IR Predictors") is the datatype of the top few stack elements. Thus it is obvious to the skilled person that the state machine comprises a syntactic model of the intermediate code.

claim 5: In the method disclosed in document D2, one of the computed predictors (page 243, section "IR Predictors") is the stack height. Thus it is obvious to the skilled person that the state machine comprises an execution model of the intermediate code.

claim 6: When applying the teaching of document D2 to the intermediate code generated by the method disclosed in document D1, which intermediate code comprises compiler information in the form of additional attributes, it would be obvious to the skilled person to improve the statistical model, and thus the compression ratio, by providing predictors based on the compiler

information, i.e., by providing the state machine with a model of the compiler information.

claim 7: In the method disclosed in document D1, storing the compressed intermediate representation is an obvious design possibility for the skilled person, and is hinted at on page 6, line 10-14 (The generation of the optimization information ... is performed ahead-of-time. The code preparation system operates ... irrespective of time ...); the decoding stage is performed in connection with a subsequent execution of the generated executable program code (page 6, line 8-10, the optimization information is provided to the JIT compiler, which, as is known in the art, compiles intermediate code into executable program code in connection with a subsequent execution of said executable program code).

claim 8: In the method disclosed in document D1, the step of further compiling the transformed code comprises further optimizing the executable code (D1, page 3, line 15-17, the intermediate code is executed more efficiently).

claim 9: In the method disclosed in document D1, the input code may be Java bytecode (D1, page 3, line 19-22).

claim 10: The code interpretive runtime environment may execute in a digital personal assistant (D1, page 3, line 15-18), which is a mobile terminal.

claim 11: The intermediate code comprises a number of code elements (e.g. Java bytecodes, cf. D1, page 3, line 19-23); the method disclosed in document D2 comprises determining a probability distribution of code elements for each leaf of the decision tree (page 243, section "Background: Machine learning of decision trees"), which is statistical information.

Thus no inventive step is present in the subject-matter of claims 2-11 (Article 33(3) PCT).

4 The features of each of the independent claims 12-19 largely correspond to features of claim 1, the subject-matter of which has been determined not to involve an inventive step. Therefore, by substantially the same reasoning as in point 2, the subject-matter of claims 12-19 does not involve an inventive step (Article 33(3) PCT).